REMARKS

Reconsideration and allowance of this application, as amended, are respectfully requested. Claims 1-24 are pending. Claims 1-22 and 24 stand allowed.

Claim 23 stands rejected under 35 USC 102(b) as being anticipated by Tanigawa (US Patent 5,925,033). This ground of rejection is respectfully traversed.

Claim 23 is reproduced below with bold and italics added for emphasis of portions being discussed below.

23. A stereo matching apparatus comprising:

a stereo camera system for taking pictures of a predetermined area and producing first and second images of the predetermined area;

a reference pixel region identifying unit for identifying a reference pixel region in the first image;

a search range identifying unit for identifying a search range for the reference pixel region in the second image;

a correction unit for ***correcting a location of the search range*** for the reference, pixel region based on the amount of deviation of an infinite distance corresponding point with respect to a horizontal position of the reference pixel region; and

a correlated destination identifying unit for identifying a correlated destination of the reference pixel region by searching through the search range,

wherein said amount is individually set for each reference pixel region in the first image ***so as to set the search range in the second image*** in relation to a position of the reference pixel region in the first image.

Correcting a location of search range.

Generally, a stereo matching apparatus obtains a distance to an object by comparing a pair of images taken by right and left cameras, identifying a plurality of correlated points on each image and calculating parallax on each point. In the process of identifying correlated points, it is not practical to search the entire image. Therefore, the searching range is limited to a certain area, e.g. a predetermined area located to the right with respect to a point where the correlated point is located most leftward, or the infinite distance corresponding point. See Description of Related Art.

However, when a search range is limited, distortion of a camera lens or an error in camera mounting can cause a failure to identify points on the pair of images that are correlated. There may not be any correlated points in the search area selected. One approach to solving this problem is to set a larger search range according to the maximum deviation expected. However, the larger the search range, the more computational overhead is required in order to find matching points. This computational overhead reduces processing speed.

The claim 23 invention provides a stereo matching apparatus that determines a search range variably for each location of an image. It sets an appropriate search range for each reference pixel block by correcting the location of the search range. Using this approach, it is not necessary to set a large margin for the search range considering a maximum deviation of the infinite distance corresponding point.

Examiner Comments in Office Action

With respect to claim 23, the Examiner stated in the official action (emphasis added):

The Tanigawa reference discloses the distance detection circuit or address generator ***corrects each window or location of the range*** by using the bias (bs) or amount of deviation on the parallax at a point a [of?] infinity with respect to the referenced pixel region (see column 4, lines 10-14 and 22-55 and column 8, lines 37-55). The amount of deviation of an infinite distance corresponding point is individually set for each reference region in the first image ***so as to set the search window or range location in the second image*** according to the first image (see column 9, lines 5-25: the bias (BS) calculated from the deviation from the first window is used as a coefficient in the polynomial added or subtracted from the value of the search window of the second image to correct the value).

Tanigawa's disclosure

Tanigawa does not teach limiting the search range. Tanigawa's object is to correct the obtained distance or parallax value in each window ***after*** matching correlating points. According to the Examiner, the bias "bs" is used ***so as to set the search window or range location in the second image***. Let's look at what Tanigawa says about bias bs:

> *The processor 50 calculates the error Δbs used to provide a correction for each window W by applying to the polynomial Fn the values of the coefficients P to S read out from the storage device 52, and the values of the number variables (i) and (j) for the window, and then corrects a detected value of an actual image by adding or subtracting the error Δbs to or from the value. The processor 50 corrects the parallax σ as an index for a distance using the following equation:*

$$\sigma = s - (bs + \Delta bs) \qquad \textit{(Column 8 ,lines 45-55)}$$

This paragraph says that Δbs is variable from window to window W. The specification does not suggest that the bias bs varies within each window W. The bias bs is used as a coefficient in the polynomial added or subtracted from the distance or parallax value of the search window of the second image to correct the value, but not to correct the search range in the process to identify correlation points between two images.

As for identifying a correlated point between two images, Tanigawa says (emphasis added):

> *To detect a parallax between the pair of images within a window, one pair of window-part data points may be shifted to each other while checking how they match, and when a match is detected, the corresponding shift value may be assumed to be a parallax expressed as a number of sensor data. (Column 1, lines 60-65)*
>
> *Each distance detection circuit 40 sequentially checks the correlations between the window-part data WD1 and WD2, which are obtained by gradually and relatively shifting the data, as in the prior art, and determines as a parallax the shift value at which the best correlation is obtained. Since, this correlations check requires some time, the detection circuits 40 are preferably incorporated in a single semiconductor integrated circuit so as to concurrently detect the parallaxes σ for the relative windows, thereby maximizing detection speed. The semiconductor integrated circuit is preferably a gate array that can be configured as a circuit adapted for each application. (Column 4, lines 10-21)*
>
> *When the distance (d) is infinite and the variable 1/d is 0, the parallax σ is also 0, but if the parallax becomes negative for any reason, such as a detection error, it makes subsequent data processing difficult. Thus, the distance detection circuit 40 conveniently detects a calculated parallax (s) obtained by superposing a predetermined bias bs on the parallax. The bias bs represents a shift value at a point at infinity used in detecting the parallax. (Column 4, lines 31-39)*

> *In order to allow the distance detection circuit 40 to detect the calculated parallax (s), a reference point, which is used to check the correlations between the window-part data WD1 and WD2 while sequentially shifting them, may simply be offset from its original position at the beginning of the detection process. (Column 4, lines 40-45)*

Tanigawa teaches only shifting concurrently when shifting the detected point to identify correlated points between WD1 and WD2. The bias "bs" is used ***just to prohibit the parallax from being negative value***. To do so, the apparatus offsets the reference point from its original position at the beginning of the process, that does not means limiting the searching area. Based on Applicant's reading of the specification, Tanigawa has no idea about limiting the searching area when identifying correlation points between two images. As describe above, Tanigawa solves the processing speed problem only by the concurrent processing. Tanigawa does not consider image recognition which has to detect multiple objects as in the case of our claim 23 invention. Rather, Tanigawa considers only distance detection to prevent collision with the vehicle in front, which is a significantly more simple problem than multiple object recognition. See column 1, lines 18-22.

Conclusion

Applicant believes that the claim 23 invention, including correcting a location of the search range for each pixel, is not specifically taught or even suggested by Tanigawa. In view of the above, allowance for claim 23 in addition to claims 1-22 and 24 is respectfully solicited.

The Commissioner is hereby authorized to charge any additional fees, which may be required for this amendment, or credit any overpayment to Deposit Account No. 02-4300, order number 032405.047.

Respectfully submitted,

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